PCT/IB04/00706

Sertifikaat | *Certificate*

REPUBLIEK VAN SUID AFRIKA | REPUBLIC OF SOUTH AFRICA

PATENT KANTOOR
DEPARTEMENT VAN HANDEL EN NYWERHEID

PATENT OFFICE
DEPARTMENT OF TRADE AND INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

REC'D 17 MAY 2004
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the documents attached hereto are true copies of the Forms P2, P6, provisional specification of South African Patent Application No. 2003/2083 in the name of Element Six (Pty) Ltd

Filed : 14 March 2003

Entitled : Tool Insert

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Geteken te / Signed at **PRETORIA** in die Republiek van Suid-Afrika, hierdie / in the Republic of South Africa, this 29th dag van / day of **March 2004**

Rlgoepe
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Registrar of Patents

FORM P.2

REPUBLIC OF SOUTH AFRICA	REGISTER OF PATENTS	PATENTS ACT, 1978

OFFICIAL APPLICATION			LODGING DATE: PROVISIONAL		ACCEPTANCE DATE	
21	01	2003/2083	22	14 MARCH 2003	47	
INTERNATIONAL CLASSIFICATION			LODGING DATE: COMPLETE		GRANTED DATE	
51			23			

FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)

71 ELEMENT SIX (PTY) LTD

APPLICANTS SUBSTITUTED:		DATE REGISTERED
71		

ASSIGNEE(S)		DATE REGISTERED
71		

FULL NAME(S) OF INVENTOR(S)

72
1. ACHILLES, ROY DERRICK
2. ROBERTS, BRONWYN ANNETTE
3. DAVIES, GEOFFREY JOHN

PRIORITY CLAIMED	COUNTRY		NUMBER		DATE	
N.B. Use International abbreviation for country (see Schedule 4)	33	NIL	31	NIL	32	NIL

TITLE OF INVENTION

54 TOOL INSERT

ADDRESS OF APPLICANT(S)/PATENTEE(S)

DEBID ROAD, NUFFIELD, SPRINGS, 1559, GAUTENG, SOUTH AFRICA

ADDRESS FOR SERVICE		S & F REF
74	**SPOOR & FISHER, SANDTON**	PA134730/P

PATENT OF ADDITION NO.		DATE OF ANY CHANGE
61		
FRESH APPLICATION BASED ON		DATE OF ANY CHANGE

SPOOR & FISHER

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT
AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30 (1) – Regulation 22)

REPUBLIC OF SOUTH AFRICA
REVENUE
FORM P.1
14.03.03 R 0060.00
HASR 711
REPUBLIEK VAN SUID AFRIKA

The granting of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

OFFICIAL APPLICATION NO.			S & F REFERENCE
21	01	2003/2083	PA134730/P

FULL NAME(S) OF APPLICANT(S)

71	ELEMENT SIX (PTY) LTD

ADDRESS(ES) OF APPLICANT(S)

	DEBID ROAD, NUFFIELD, SPRINGS, 1559, GAUTENG, SOUTH AFRICA

TITLE OF INVENTION

54	TOOL INSERT

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. THE EARLIEST PRIORITY CLAIM IS:

COUNTRY: NIL NUMBER: NIL DATE: NIL

~~THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.~~

21	01	

~~THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND IS BASED ON APPLICATION NO.~~

21	01	

THIS APPLICATION IS ACCOMPANIED BY:

- ☒ 1. A single copy of a provisional specification of 7 pages.
- ☐ 2. Drawings of sheets
- ☐ 3. Publication particulars and abstract (Form P.8 in duplicate).
- ☐ 4. A copy of Figure of the drawings (if any) for the abstract.
- ☐ 5. Assignment of invention.
- ☐ 6. Certified priority document.
- ☐ 7. Translation of the priority document.
- ☐ 8. Assignment of priority rights.
- ☐ 9. A copy of the Form P.2 and the specification of S.A. Patent Application No .
- ☐ 10. Declaration and power of attorney on Form P.3.
- ☐ 11. Request for ante-dating on Form P.4.
- ☐ 12. Request for classification on Form P.9.
- ☒ 13. Form P.2 in duplicate.
- ☐ 14. Other.

74	ADDRESS FOR SERVICE: SPOOR & FISHER, SANDTON

Dated: 14 March 2003

SPOOR & FISHER
PATENT ATTORNEYS FOR THE APPLICANT(S)

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
2003 -03- 14
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE

REGISTRAR OF PATENTS

SPOOR & FISHER

FORM P.6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) – Regulation 27)

OFFICIAL APPLICATION NO.

21	01	2003/2083

LODGING DATE

22	14 MARCH 2003

FULL NAMES OF APPLICANTS

71	ELEMENT SIX (PTY) LTD

FULL NAMES OF INVENTORS

72	ACHILLES, ROY DERRICK ROBERTS, BRONWYN ANNETTE DAVIES, GEOFFREY JOHN

TITLE OF INVENTION

54	TOOL INSERT

This invention relates to tool inserts and more particularly to cutting tool inserts for use in drilling and coring holes in subterranean formations.

A commonly used cutting tool insert for drill bits is one which comprises a layer of polycrystalline diamond (PCD) bonded to a cemented carbide substrate. The layer of PCD presents a working face and a cutting edge around a portion of the periphery of the working surface.

Polycrystalline diamond, also known as a diamond abrasive compact, comprises a mass of diamond particles containing a substantial amount of direct diamond-to-diamond bonding. Polycrystalline diamond will generally have a second phase which contains a diamond catalyst/solvent such as cobalt, nickel, iron or an alloy containing one or more such metals.

In drilling operations, such a cutting tool insert is subjected to heavy loads and high temperatures at various stages of its life. In the early stages of drilling, when the sharp cutting edge of the insert contacts the subterranean formation, the cutting tool is subjected to large contact pressures. This results in the possibility of a number of fracture processes being activated such as :

i. fatigue cracks being initiated
ii. high energy impacts, in the normal direction, resulting in spalling of the PCD layer
iii. high energy impacts in the cutting direction, resulting in chipping of the PCD layer

As the cutting edge of the insert wears, the contact pressure decreases and is generally too low to cause high energy failures. However, this pressure can still propagate cracks initiated under high contact pressures; and will eventually result in spalling-type failures.

Spalling failures are particularly damaging in that these failures represent a mechanism for the rapid removal of wear resistant material and consequently reduce the life of the cutting tool insert. Localised spalling leads to a localised thinning of the PCD table which in turn gives rise to a grooving type of wear. This wear phenomenon redistributes the loading on the wearflat and results in an increase in the contact pressure. As the grooving wear continues, the contact pressure will continue to increase, eventually initiating spalling type failures from the high contact pressure areas. In a worst case scenario, this becomes a self-sustaining wear mode that will lead to the premature failure of the cutting tool due to the rapid removal of the PCD layer by a spalling mechanism

United States 5,135,061 describes a cutting tool insert for use in rotary drill bits of the kind generally described above. The cutting element has a layer of superhard material such as PCD bonded to a cemented carbide substrate. The layer of superhard material has a front layer at the cutting face and a second layer behind the front layer. The front layer comprises a form of superhard material which is less wear-resistant than the super-hard material forming the second layer. Generally, a plurality of further layers are stacked behind the second layer, the further layers being of reducing wear-resistance as they extend away from the second layer towards the substrate.

According to the present invention, a tool insert comprises a layer of ultra-hard abrasive, particularly PCD, bonded to a substrate along an interface, the layer presenting a working surface and a periphery around the working surface which provides a cutting edge for the insert, the layer of ultra-hard abrasive

having a first region extending into the layer from the working surface, and a second region in contact with the first region, the first and second regions having one or more of the following characteristics:

i) the wear resistance of the first region is less than that of the second region;

ii) the first and second regions are both regions of PCD and contain catalyst/solvent, the amount of catalyst/solvent in the first region being higher than that in the second region;

iii) the first region has ultra-hard abrasive particles of a unimodal particle size distribution only, and the second region has ultra-hard abrasive particles which have a multimodal size distribution;

iv) both the first and second regions comprises ultra-hard abrasive particles of more than one particle size, the size distribution of the particles in the first region being coarser than that of the second region;

v) the ultra-hard abrasive is PCD and the thermal stability of the PCD in the first region is less than that of the PCD in the second region;

vi) the ultra-hard abrasive is PCD and sinter quality of the PCD in the first region is compromised by the introduction of a material such as a sintering agent in small quantities, which is not introduced into the second region; and

vii) both the first and second regions are regions of PCD containing a catalyst/solvent in a second phase. The catalyst/solvent in the first region is cobalt with another transition metal such as nickel, or the other transition metal; and the catalyst/solvent in the second region is essentially cobalt.

Generally, the first and second regions will comprise layers extending from the working face into the working layer. The regions, or at least one of the regions, may comprise an annulus extending inwards from a periphery of the layer of ultra-hard abrasive. In some cases, the thickness of the first, thin region may be non-uniform across the diameter of the cutter; so that the interface between the first and second regions may be specifically designed for optimal behaviour.

Essential to the invention is that the first region differs in material characteristics to that of the second region leading to a controlled and reduced spalling and reduced fatigue in the layer of ultra-hard abrasive. The first region will generally be relatively thin and extend to no more than 500 microns from the working surface.

When the regions have the characteristics set out in paragraphs (i), it is preferred that there is a relationship between the wear resistances of the two regions to achieve a minimising of the failure problems of prior art tool inserts described above. Preferably the first region has a wear resistance of between 50% and 90% of the wear resistance of the second region. An example of regions having the characteristics set out in paragraph (i) is one in which the first region comprises a composite structure of two or more materials. The materials may be uniformly distributed throughout the region or randomly distributed. For example, the one material may be the same material as that of the second region and this will be combined with another material which provides that first region with a wear resistance lower than that of the second region.

When the regions have the characteristics set out in both paragraphs (ii) and (iii), it is preferable that the average grain or particle sizes in the two regions are similar. In other words, the range of particle sizes in the second region will

not differ materially from the particle size of the ultra-hard abrasive in the first region.

When the regions have the characteristics set out in paragraph (iv), the ultra-hard abrasive in the first layer is preferably made from a mass which comprises at least 25% by mass particles having an average particle size in the range 10 to 100 microns and consisting of particles having three different average particle sizes and at least 4% by mass of the particles having an average particle size of less than 10 microns. Further, the ultra-hard abrasive in the second region preferably is made from a mass of particles which has an average particle size of less than 20 and consists of particles having at least three different average particle sizes.

When the regions have the characteristics set out in paragraph (v), a metal or other material which has thermal expansion properties significantly different to that of PCD may be provided in the first region. Also, the first region may have a second phase which includes in it a metal such as iron or manganese which can react with the diamond under high temperature.

When the regions have the characteristics set out in paragraph (vi), the compromising material will generally be present in quantities sufficient for the mechanical or thermal properties of the material itself to affect the properties of the first region. The role of the compromising material is to influence the diamond sintering process during synthesis. This may be achieved in one of two ways. First, the material may act as an inhibitor/poison where the agent interfers with the sintering. Second, the material may be more catalytic, for example where the presence of the material encourages sintering, but at a too rapid rate, producing a less well-sintered structure. Further examples of compromising the quality of the PCD is by treatment of the diamond particle surface or the introduction of additional carbon material into the first region.

When the regions have the characteristics set out in paragraph (vii), a catalyst/solvent such as nickel may be present in the first region. The nickel will tend to increase the thermal stability of the PCD in the first region. However, the sintering action of the nickel is less effective than another transition metal such as cobalt. Thus, the presence of nickel in the PCD in the first region, where the other catalyst/solvent is cobalt, will have the effect of reducing the overall strength of the sintered PCD in the first region and hence rendering it less wear resistant.

The invention has particular application to tool inserts wherein the ultra-hard abrasive is PCD and, more particularly, to such inserts which are intended to be used as cutting inserts for drill bits in the drilling or coring of drill holes or the like in subterranean formations.

Dated this 14th day of MARCH 2003

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Spoor & Fisher
Applicant's Patent Attorneys